Calorimetry: Physical Processes HW #1 to 7 (handout)

Solutions:

#1) $\Delta H = 400\,g \times \frac{1\,mol}{18.01\,g} \times \frac{6.01\,kJ}{1\,mol} = 13.3\,kJ$

#2) $\Delta H = 50.0\,g \times \frac{1\,mol}{18.01\,g} \times \frac{40.7\,kJ}{1\,mol} = 113\,kJ.$

#3) ① steam at 100°C to liquid at 100°C ⇒ need $\Delta H_{cond} = -40.7\,kJ/mol$
+ ② liquid at 100°C to liquid at 35°C ⇒ $Q = mc\Delta T$

$\Delta H = 500\,g \times \frac{1\,mol}{18.01\,g} \times \frac{-40.7\,kJ}{1\,mol} + 500\,g \times 4.18\,J/g°C \times (35-100)$

$= -1129.9\,kJ + (-135850)\,J$

$= -1129.9\,kJ - 135.850\,kJ$

$= -1265.75\,kJ$

$= -1266\,kJ$

#4) ① ice −10°C to 0°C ③ H_2O 0°C to 20°C
② water 0°C to 0°C

$0.20\,kg \times 1000\,g/kg$

$\Delta H = $ ① $0.20\,kg\ ice \times \frac{1000\,g}{1\,kg} \times \frac{2.11\,J}{g°C} \times (0-(-10))$

$= 4220\,J$ or $4.22\,kJ$

+ ② $200\,g \times \frac{1\,mol}{18.01\,g} \times \frac{6.01\,kJ}{1\,mol}$

$66.7\,kJ$

+ ③ $+ 200\,g \times \frac{4.18\,J}{g°C} \times (20°-0°C)$

$+ 16.72\,kJ$

$= 4.22 + 66.7 + 16.7$

$= 88\,kJ$

#5) ① ice $-5.0^\circ C \rightarrow 0^\circ C \rightarrow 0^\circ C \rightarrow 100^\circ C \rightarrow 110^\circ C$

$m = 0.100\,kg \times 1000\,g/kg$

$m = 100\,g$

$n = \frac{100\,g}{18.01} = 5.55\,mol$

$\Delta H = m_{ice} c_{ice} (5^\circ C) + n \times \Delta H_{melt} + m_{H_2O} c_{H_2O} (100^\circ C) + n \times \Delta H_{vap} + m_{steam} c_{steam} (10^\circ C)$

$= 100\,g \times \frac{2.01\,J}{g^\circ C} \times 5^\circ C + 5.55\,mol \times \frac{6.01\,kJ}{mol} + 100 \times 4.18 \times 100 + 5.55 \times 40.7 + 100 \times 2.0 \times 10$

$= 1005\,J + 33.4\,kJ + 41800\,J + 222.4\,kJ + 2000\,J$

$= 1.005\,kJ + 33.4\,kJ + 41.800\,kJ + 222.4\,kJ + 2.00\,kJ$

$= 301\,kJ$

#6) Total Energy change $= 25.5\,kJ$

$25.5\,kJ = \underbrace{n \times \Delta H_{melt}}_{melting} + \underbrace{m c \Delta T}_{going\ from\ 0^\circ\ to\ 25^\circ C}$

$25500\,J = \frac{m}{18.01\,g/mol} \times \frac{6.01\,kJ}{1\,mol} \times \frac{1000\,J}{kJ} + m \times 4.18 \times 25$

$25500 = 333.7\,m + 104.5\,m$

$25500 = 438.2\,m$

$\frac{25500}{438.2} = m \quad \therefore m = 58.2\,g$

#7) $Q = 40\,g \times 2.11\,J/g^\circ C \times (-15 - (-5))$

$= 40 \times 2.01 \times (-10)$

$= -804\,J$